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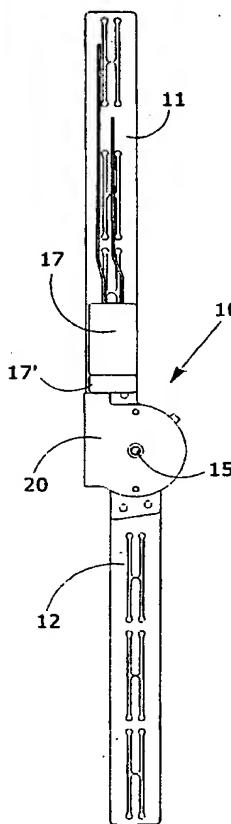
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(54) Title: ARTICULATED JOINT FOR KNEE BRACE COMPRISING MEANS FOR OPERATING THE SAME



(57) Abstract: An articulated joint (10) for a post-operative knee brace or for articular walkers in general, of the type designed to form an articulated connection between a pair of uprights (11, 12) each of which can be applied to two sectors of the body joint to be treated, is described. Power-driving means for the angular movement of one upright with respect to the other are fitted at the hinge point connecting the two uprights.



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"ARTICULATED JOINT FOR KNEE BRACE COMPRISING MEANS FOR OPERATING THE SAME"

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TECHNICAL FIELD

This invention concerns an articulated joint for a knee brace or for articular walkers in general, with the particular feature of being equipped with power-driven 10 operating means.

More in particular, this invention refers to an articulated joint for a knee brace which is designed to be fitted with a power-driven system that makes it possible to mechanically and automatically vary the opening angle 15 of the two uprights which it joins together.

This power-driven system uses an electrical type of motor, which can be connected to a control unit or to a PLC, and can be fitted on the brace in an operating position kinematically connected to one of the uprights.

20 The use of the power-driven system fitted to the orthopaedic walker allows the walker to be used for rehabilitation exercises of the limb after surgery or as part of articular excursion rehabilitation therapy.

25 This invention can be applied in the industry for the production of orthopaedic equipment and in particular equipment such as knee braces or the like to control isometric flexure of the limbs.

BACKGROUND ART

30 It is known that following surgery to the arms and legs it is necessary for the patient to wear auxiliary equipment or orthoses, that is to say fixed or mobile equipment that increases, improves or controls the impaired function of body parts, such as walkers or the

like, and to undergo rehabilitation cycles to restore the limb to perfect condition.

After an operation on the ligaments or cartilaginous membranes, the limb is kept in a blocked position, first 5 totally then partially, by means of special orthopaedic equipment generally called walkers or knee braces, which assist and support the weakened joint, absorbing the most intense stress.

10 The first exercises recommended are passive flexure-extension and circumduction movements: these movements are very useful in stimulating the circulation of the limb and activating the muscular structure.

15 In the last few years, closed kinematic chain exercises, in which both the proximal and distal ends of the system are blocked, have been widely employed to optimise the initial healing phase of ligament transplants.

20 In order to perform flexure-extension limb rehabilitation exercises, the devices currently used allow passive movement of the joint. These devices allow the limb to be stretched out in a substantially horizontal position, while the person is sitting or lying down, and to be flexed with a progressive increase of the angle as the rehabilitation programme proceeds.

25 These kinetic type devices normally consist of a frame with support means for the leg or the arm, which are kept in an extended position, and adjustable angle thrust or flexure means, with excursions from 0 to 90 and 120°.

30 These devices are normally used while the person is lying down or sitting, and therefore, in addition to being fairly complex and cumbersome, cannot be used in other positions.

DESCRIPTION OF THE INVENTION

This invention proposes to provide an articulated joint for a walker, for example part of a knee brace type device, or also for application on ankles, arms or other parts of the body comprising joints, which is able to eliminate or at least reduce the disadvantages described above, being equipped with power-driving means.

In this case, the walker that allows the limb to be held in a condition of safety can also become a means of passive rehabilitation, thus avoiding the need to use additional equipment.

The invention also proposes to provide a power-driven articulated joint that is easy to produce in such a way as to be economically advantageous.

This is achieved by means of a power-driven joint with the features described in the main claim.

The dependent claims describe advantageous embodiments of the invention.

The power-driven joint according to the invention therefore comprises a pair of reciprocally hinged discs, each being integral with a respective upright fixed in turn to the user's limb.

In the case of the leg, each upright is fixed to the femoral sector and to the tibial sector, but advantageously the device also foresees the use of any other kind of joint and for any type of articular trauma, to the lower or upper limbs.

In the post-traumatic treatment of joints, it is normally indispensable for the angular extension between one disc and the other to be limited within a range that gradually increases as time passes; a different degree of control must also be ensured for angular extension movement with respect to flexure movement.

The adjustment of these oscillatory distances must be

carried out by specialised personnel or, following precise instructions of the doctor, by the user who can intervene directly on his/her brace.

The articulated joint must therefore present devices 5 which are easily adjustable and easy to maneuver.

The invention in question proposes to motorize this type of joint by using an electrical type motor, and more specifically the stepping type motor, which can generate controlled angular movements of one upright with respect 10 to the other.

The motor fitted on the joint can be fixed by very easy to use means on the device, for example on one of the uprights, and foresees that its shaped operating pin is directly inserted in a corresponding shaped hole of the 15 joint, thus angularly moving one upright with respect to the other.

The angular movements imparted can be managed and controlled by a PLC or by another control system on which it is possible to set both the size of the angles and the 20 speed of the movement.

The main advantages of this solution, in addition to those deriving from the construction simplicity rather than the traditional complexity and the difficulty in using known kinetic type equipment, are a considerable 25 saving in costs, since the same device that allows support of the limb in the post-operative period also makes it possible to carry out cycles of passive rehabilitation with controlled angular movements at an intensity that gradually increases as time passes.

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DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will become evident on reading the following description of one embodiment of the invention, given as a non-binding

example, with the help of the drawings shown in the attached pages, in which:

- figure 1 represents a side schematic view of an articulated joint fitted between the respective uprights and equipped with the power-driven system according to the invention;
- figure 2 represents a front schematic view;
- figure 3 is a plan schematic view of the power-driven joint;
- 10 - figure 4 is an axonometric view of a joint complete with uprights and equipped with power-driving means;
- figure 5 shows the power-driving means and its gears partially transparent;
- figure 6 shows a front schematic view;
- 15 - figure 7 shows an axonometric schematic view;
- figure 8 represents a detailed view of an articulated joint equipped with power-driving means;
- figure 9 shows an axonometric exploded view of the joint fitted on the uprights and equipped with power-20 driving means.

DESCRIPTION OF ONE EMBODIMENT OF THE INVENTION

The articulated joint 10 according to the invention is part of a post-operative knee brace or other equipment comprising uprights 11 and 12 which, in the case of the leg, are respectively fixed to the femoral sector and to the tibial sector, but which advantageously also foresees the use of articulated joints of any kind and for any type of articular trauma of the upper or lower limbs.

30 According to the invention, the articulated joint 10 comprises at least one pair of discs 13 and 14, which may be equipped with stop teeth, respectively integral with the femoral upright 11 and the tibial upright 12, considering that the terms used here with reference to the

knee can also refer to other joints of the upper or lower limbs.

According to the invention, the joint presents means designed for the reciprocal angular movement of the two uprights for adjustment of the angle of flexure and the angle of extension.

The two discs 13 and 14 are connected and integral with the femoral upright 11 and the tibial uprights 12, and are connected together by means of a rotation pin 15 common to both.

The joint may also comprise means of elastic loading, consisting for example of a helical spring, one end of which is directly or indirectly in contact with the central pin of the joint and the other end in contact with the pin or part of the upright to which it is directly connected.

This means of elastic loading can advantageously be inserted in a specific housing in the body of the strip.

As stated above, the joint is normally equipped with teeth that, at the end of the allowed movement, strike an appropriate pin, thus limiting the angular movement of the tibial upright with respect to the femoral upright.

The independent movement of the pins inside other notches available in the respective circumferential slots in the joint ensures a different angular movement and thus an adjustment of the angle of flexure and the angle of extension.

According to the invention, the joint can be equipped with power-driving means which allow the angular movement of the uprights in order to move the body joint on which the device is fitted.

In particular, the power-driving means consist of a pinion 16 of a unit which is kinematically connected to an electrical type motor 17 and to a reduction gear unit 17'.

More specifically, the pinion 16 is part of and integral with a toothed pulley 18 which engages with a worm screw 19 driven by the shaft of the motor 17.

5 The worm screw 19 is positioned at a tangent to the pulley 18 and both the screw and the pulley are enclosed in a container 20 which has approximately the same surface extension as the discs 13 and 14 over which it is positioned.

10 The pinion 16, which presents a longitudinally shaped conformation, for example hexagonal, triangular, polygonal, toothed or similar, is inserted in an appropriate corresponding housing 21 in the pin 15 of the joint, and more specifically in a housing of the pin integral with one of the two uprights.

15 In the case in question, the motor 17 and the drive and reduction unit enclosed in the container 20 are fitted on the femoral upright 11.

20 The pinion 16 is in turn shaped so as to penetrate the corresponding female hole 21 of the pin 15, which is therefore integral with the tibial upright 12.

In this way a rotation of the pinion 16 causes an angular movement of the tibial upright with respect to the femoral upright.

25 The drive unit, consisting of the motor 17 and the container 20 holding the kinematic movement transmission organs, is fitted on a support plate 22 equipped on the opposite side with protruding centering teeth 23.

The teeth 23 are shaped and arranged so they can be inserted in corresponding housings 24 in the upright 11.

30 A locking clip 25 with a substantially "C" shaped cross-section, or another similar shape, clamps the plate 22 on the upright 11.

The motor 17 is connected by appropriate cabling 26 to a power takeoff which can be represented by a storage

battery or a network source, and the motor can be connected to a PLC control unit or the like, which acts by keyboard commands.

5 In this way it is possible to control the angle of movement of the uprights, starting from narrow angles at the start of treatment with a gradually increasing intensity in relation to time.

It is also possible to control the speed of the movements according to requirements.

10 The joint and the parts that make up the movement system can be made from lightweight metal alloy or from high-resistance composite plastic.

15 According to the invention, the power-driving system may also be removable, being fitted and held in place only when the movement system is actually being used.

It is also possible to foresee that, with an appropriate modification to the hinge pin of the upright joint, all existing similar brace devices can be equipped with the power-driving system.

20 The invention is described above with reference to a preferred embodiment. It is nevertheless clear that the invention is susceptible to numerous variations that lie within the framework of technical equivalents.

CLAIMS

- 1) An articulated joint for a post-operative knee brace or for articular walkers in general, of the type designed to form an articulated connection between a pair of uprights each of which can be applied to two sectors of the body joint to be treated, characterised in that power-driving means for the angular movement of one upright with respect to the other are fitted at the hinge point connecting the two uprights.
- 10 2) An articulated joint according to the foregoing claim characterised in that the power-driving means consist of a shaped pinion (16) which is part of a unit kinematically connected to an electrical type motor (17) and to a reduction gear unit (17').
- 15 3) An articulated joint according to either of the foregoing claims characterised in that the pinion (16) is part of and integral with a toothed pulley (18) which engages with a worm screw (19) driven by the shaft of the motor (17).
- 20 4) An articulated joint according to any of the foregoing claims characterised in that the worm screw (19) is positioned at a tangent with respect to the pulley (18) and both the screw and the pulley are enclosed in a container (20) which has approximately the same surface extension as the joint discs (13, 14) over which it is positioned.
- 25 30 5) An articulated joint according to any of the foregoing claims characterised in that the pinion (16), which presents a longitudinally shaped conformation, for example hexagonal, triangular, polygonal, toothed or

similar, is inserted in an appropriate corresponding housing (21) in the pin (15) of the joint, and more specifically in a housing of the pin integral with one of the two uprights.

5

6) An articulated joint according to any of the foregoing claims characterised in that the motor (17) and the drive and reduction unit enclosed in the container (20) are fitted on one of the uprights (11), and the pinion (16) is in turn shaped so as to penetrate the corresponding female hole (21) of the pin (15), which is therefore integral with the other upright (12).

10

7) An articulated joint according to any of the foregoing claims characterised in that the drive unit consisting of the motor (17) and the container (20) holding the kinematic movement transmission organs, is fitted on a support plate (22) equipped on the opposite side with protruding centering teeth (23).

15

8) An articulated joint according to any of the foregoing claims characterised in that the teeth (23) are shaped and arranged so they can be inserted in corresponding housings (24) in the upright (11).

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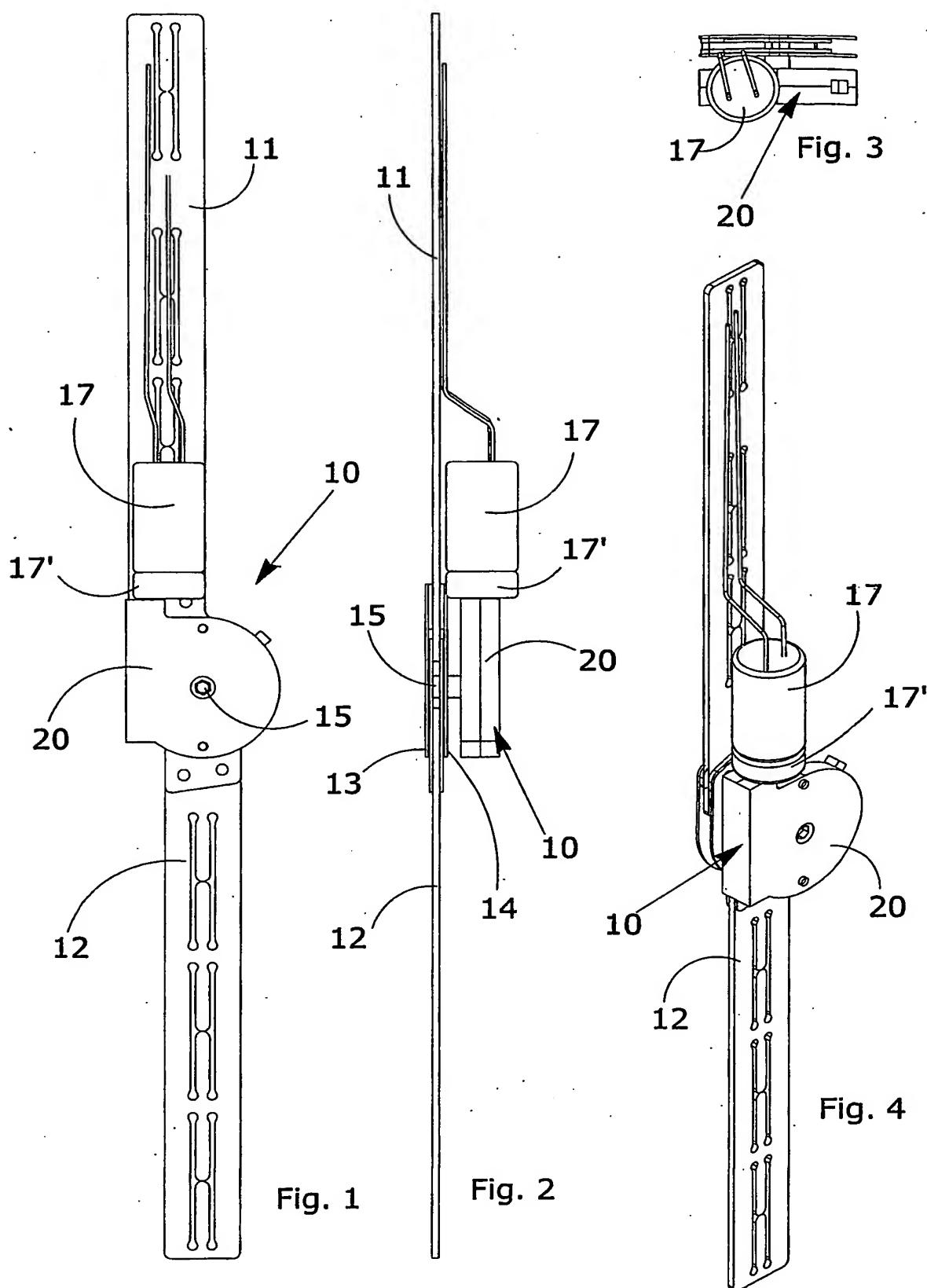
9) An articulated joint according to any of the foregoing claims characterised in that a locking clip (25) with a substantially "C" shaped cross-section, or another similar shape, clamps the plate (22) on the respective upright (11).

25

10) An articulated joint according to any of the foregoing claims characterised in that the motor (17) is connected by appropriate cabling (26) to a power

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takeoff which can be represented by a storage battery or a network source, and if necessary to a PLC control unit or the like, which acts by keyboard commands.



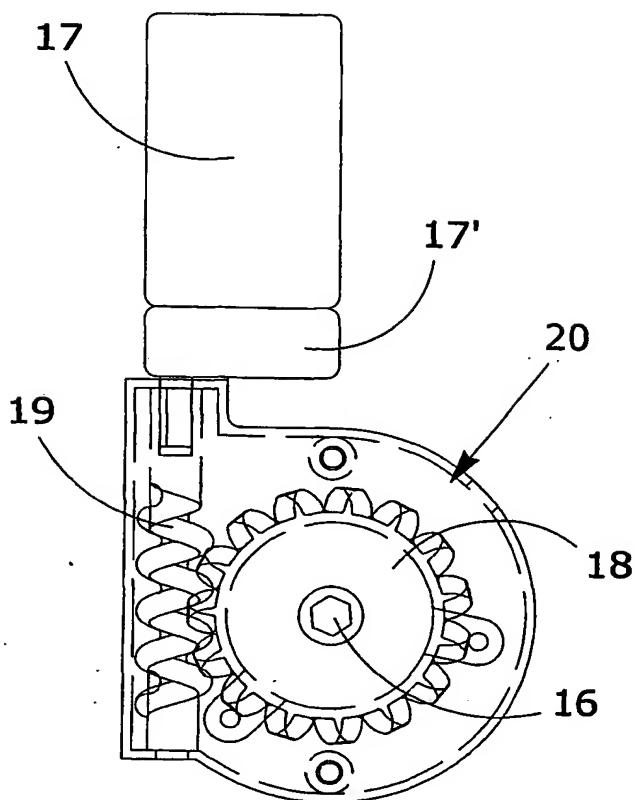


Fig. 5

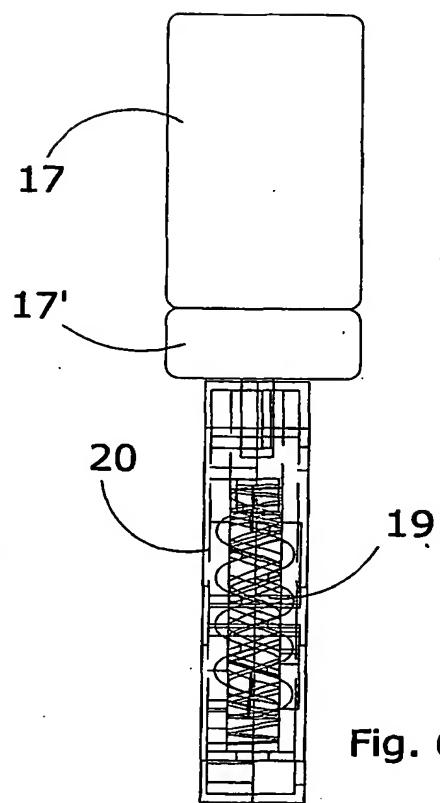


Fig. 6

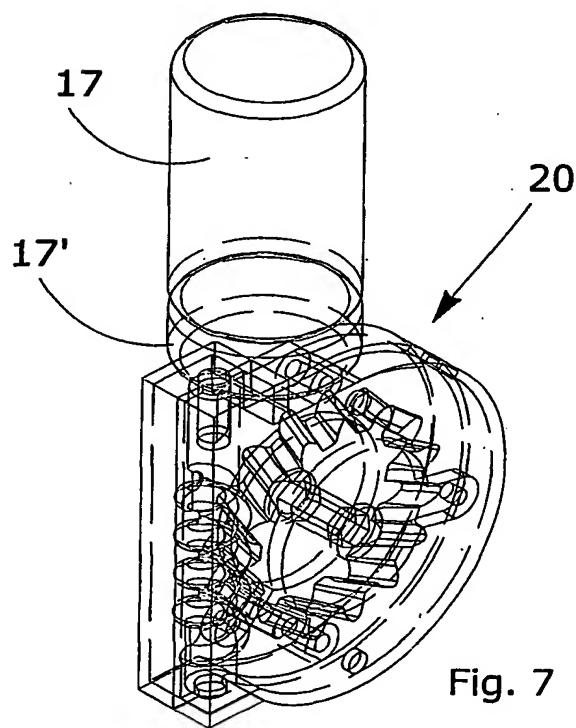


Fig. 7

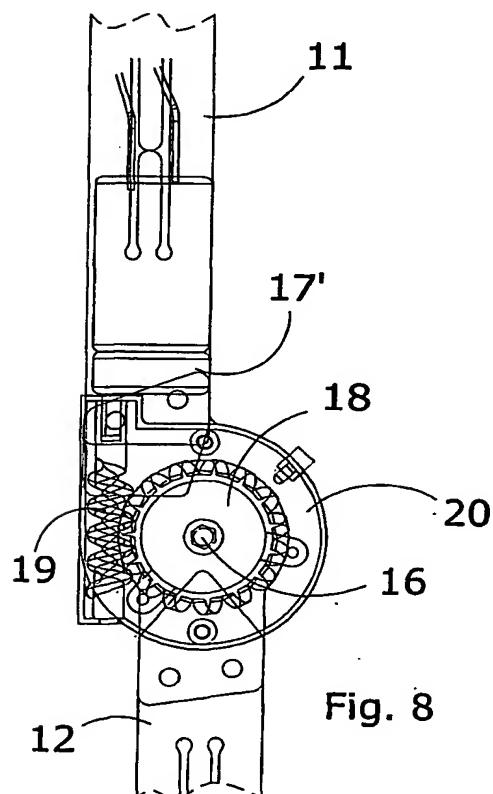
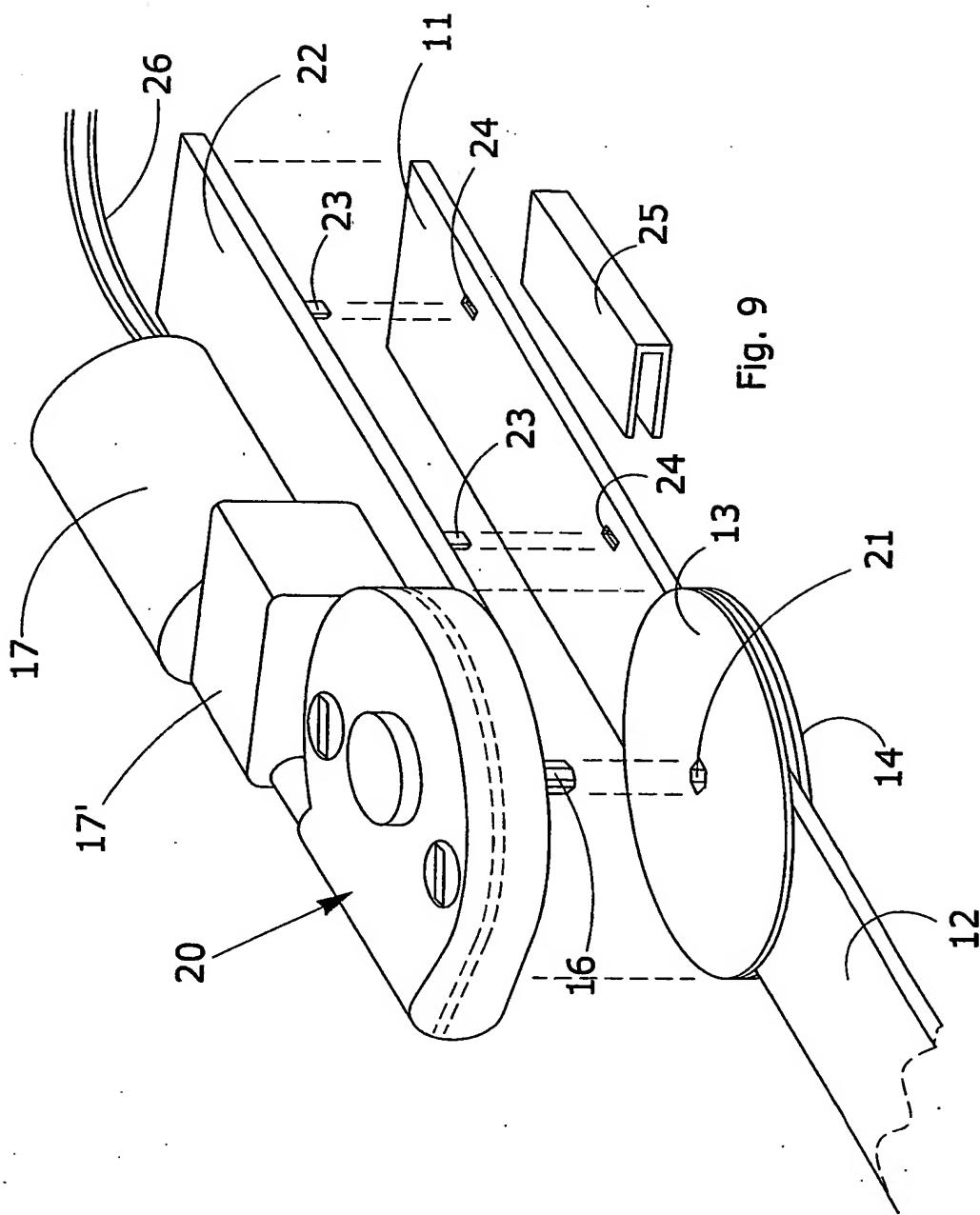


Fig. 8



INTERNATIONAL SEARCH REPORT

Inte: **nal Application No**
PC1/1T2004/000597

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F5/01 A61H1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F A61H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/092164 A (FONDATION SUISSE POUR LES CYBERTHESES; BODARD, ROLAND; CLAVEL, REYMON) 21 November 2002 (2002-11-21) page 15, line 15 – page 17, line 24; figures 1,3,4	1-4,10
X	EP 0 475 735 A (COMPAGNIE GENERALE DE MATERIEL ORTHOPEDIQUE) 18 March 1992 (1992-03-18) column 3, line 12 – column 5, line 27; claim 1; figures 2-5	1,2,10
X	EP 0 510 840 A (BONUTTI, PETER M) 28 October 1992 (1992-10-28) column 4, line 50 – column 7, line 34 column 11, line 9 – line 51; figures 5-7	1,2,10

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 538 595 A (HAJIANPOUR ET AL) 3 September 1985 (1985-09-03) column 5 - column 10; figures 28-33 -----	1-3, 10
X	US 3 449 769 A (NEIL J. MIZEN) 17 June 1969 (1969-06-17) the whole document -----	1
A	US 5 683 351 A (KAISER ET AL) 4 November 1997 (1997-11-04) the whole document -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US2004/000597

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 02092164	A 21-11-2002	CA 2446875	A1	21-11-2002
		WO 02092164	A2	21-11-2002
		EP 1387712	A2	11-02-2004
		JP 2004526541	T	02-09-2004
		US 2004172097	A1	02-09-2004
EP 0475735	A 18-03-1992	FR 2666738	A1	20-03-1992
		AU 8379591	A	19-03-1992
		CA 2051250	A1	15-03-1992
		EP 0475735	A2	18-03-1992
		JP 6023004	A	01-02-1994
		US 5273520	A	28-12-1993
EP 0510840	A 28-10-1992	US 5285773	A	15-02-1994
		CA 2066150	A1	25-10-1992
		DE 69224228	D1	05-03-1998
		DE 69224228	T2	17-09-1998
		EP 0510840	A1	28-10-1992
		US 5395303	A	07-03-1995
		US 5453075	A	26-09-1995
		US 5503619	A	02-04-1996
		US 5611764	A	18-03-1997
US 4538595	A 03-09-1985	NONE		
US 3449769	A 17-06-1969	NONE		
US 5683351	A 04-11-1997	NONE		